

Textiles Tell the Tales – Weaving the Past into Our Futures

Jennifer L. Frasher

"A small group of thoughtful people could change the world. Indeed, it's the only thing that ever has." Margaret Mead

Introduction

Ancient textile invention is a broad, and forgive the pun, intricately woven topic. Isolating a particular aspect of textiles for this unit's focus was overwhelming. My initial brainstorming web resembled an intricate fireworks display and included sections such as fibers, forms, uses, tools, economics, trade, and more. This Unit of study can be adapted to any of these areas. There are so many avenues to explore within this topic that I feel that I could teach any aspect of my curriculum through this medium. It is an extremely versatile area of study that can be lightly touched upon or intensely studied by any grade.

Choosing textiles was heavily tied to my own personal interest in fiber art. Not quite a year ago, I learned the art of needle felting, which uses a notched needle to felt wool or other organic fibers into 2D or 3D art. The art of needle felting was so appealing to me aesthetically, visually and tactually. Perhaps the ancients also reveled in the textures and properties of early plant and animal materials. My newfound interest built on experiences such as sewing, knitting, cross-stitching, macramé, and even the raising of silkworms as part of our science curriculum for over 10 years. Each of these activities required the acquisition of related knowledge and skill sets, from identifying appropriate materials to tool usage. With needle felting, I discovered a need for learning about wool and other fibers from their raw state through their processing to different forms; my previous knowledge regarding yarns and their various properties was insufficient.

I imagine my personal wool journey in many ways mirrors the progression of the ancients' pursuit of new and improved textile materials. When I first began needle felting I used a small supply of materials that were given to me, which was quickly depleted. With limited understanding of the wool and how to obtain it, I first looked to local craft stores and then to the internet. The quality of my early wool purchases was very poor, being coarse, poorly processed, and of indeterminate type. I also did not yet understand there was a vast range of different wools that would produce different results. My frustration with these early materials sparked a quest to further experiment with what I did already have, but also to dialogue with others more experienced than myself and cast a wider net for suppliers. I eventually discovered Sarafina Fiber Arts, a nearby source whose quality of materials and wealth of educational materials are in high demand across the globe. While I may still acquire a few specialty fibers elsewhere, the bulk of my

materials now come through my nearby source. Traveling to purchase those supplies has also led to me frequenting other businesses along the route. Truthfully, if I weren't limited by zoning restrictions, by now I would be keeping my own sheep and goats!

Like most of my interests over the years, my newfound passion made its way into my classroom. I brought in my wool and carding combs when we read a story from our anthology about weaving and the students were fascinated. This was something new for them and it seemed like a wonderful experience to expand upon. The topic is meaningful because textiles daily surround us. While mankind developed ways to increase production and invented synthetic fibers, the basics haven't significantly changed. There is much information students can gain from both stories and hands on experiences, as they relate to the role of textiles through the ages. The production of textiles has had, and will continue to have, cultural and environmental implications. It is an opportunity to examine how humans interact and make use of their environment, and how we can minimize negative impacts going forward.

Demographics

Population

I teach second grade at Keene Elementary school in the Christina School District. Christina has historically been the largest district and is actually spread out between the City of Wilmington and Suburban Newark.

Our school is considered a Title 1 school and has over 70% of our students receiving free or reduced lunch. The majority of our students come from non-traditional households. Many of our families are single parent or even another relative (grandparents, aunt or uncle, older sibling). It is not unusual for a family to have transportation and technology issues. We also have a large population of English Language Learners from a variety of cultures: Asian, Hispanic, Middle Eastern and the Caribbean. Despite all of these challenges, Keene is a close-knit family.

Second grade students across the grade level this year have significant behavioral issues. As a group, this has been the case for them in Kindergarten, First, and now Second grade. All five of our classrooms contain multiple students with severe behavior issues that are problematic on a daily basis. More than ever, it is imperative that we find ways to motivate and engage these students. Using a Project-based approach to content helps keep the students vested in their own learning

Location

William B. Keene Elementary School is located in a region known as "Bear" in New Castle County, Delaware. The school address is technically "Newark, Delaware" but our

location is far from the bustling college town of that name. Despite the school's proximity to some of its feeder neighborhoods, it is located between a major highway, and a strip of woods, but across from a large park. This corridor of the highway has a very transient population and many of our students come and go throughout the K-5 grade span of the school.

Neighbors

In the last year or so we have had multiple homicides in the neighborhoods immediately adjacent to the school, including one near a bus stop as students were being dropped off. It is not unusual for us to experience security lockdowns due to other local crimes including bank and pharmacy robberies, and sadly this year - clowns. Our location is also next to the Troop Two State Police Barracks, which is a mixed blessing. We have the benefit of quick security response but proximity to the comings and goings of criminals.

Another close neighbor is Fox Run Shopping Center, which houses a large Goodwill Donation Center and store that provides us with an instant textile recycling resource.

Rationale

Over the years, I have read many different books related to textiles and have always found the students curious about multiple aspects of the stories. Once I brought in my wool and related tools it was clear that this was an opportunity to get them thinking deeply about something they take for granted daily. In addition, most of my students have had no exposure to any type of farming or animal husbandry so they are full of questions and preconceived notions. Classes that once taught students handcrafts, such as sewing and woodworking, have long gone to the wayside in the competitive push for academics. Even vocational programs like Future Farmers of America (FFA) and Animal/Plant sciences are first on the chopping block when funding is lacking as my school district experienced these last few years. In our current age of technology, that knowledge and skills set are erroneously believed to be unnecessary.

We will be studying the beginnings of textiles with humans, looking at the acquisition of the needed materials, researching cultural and environmental impact, and examining how it all has changed throughout history. I hope to impress upon them how these choices become part of the daily fabric of our lives. This unit will include opportunities for the students to explore early textile production through hands on experiences and field trips. We will utilize literature to study different forms of handmade textiles from more recent history. Along the way we will pinpoint geographic and environmental signposts. Lastly, we will research current textile practices that are working to reduce negative consequences of production. Our present and future textile usage will have ramifications for centuries just as it has ever since textiles were invented.

Background

Textiles, cloth, and fabric are all names for fibers that have been woven, knitted, knotted, or felted into usable materials. These materials are then used to create a multitude of items that have significantly improved mankind's existence such as strings, nets, baskets, bags, shelters, coverings and clothing.¹ The fibers are transformed from their natural state through processes such as twisting, spinning or agitating. For ease of understanding, the terms textiles and fibers will be used to encompass these various materials throughout this Unit. It is important that students differentiate between "clothing" and "textiles" because the earliest clothing was most likely animal skins, which initially differed from their natural state only in their lack of attached flesh. In time, the skins were eventually attached or sewn together. While their "thread" was most likely sinew, Cro-Magnon Man is credited with the invention of needles that we believe they used to piece together early garments. Due to early textiles being solely organic in nature there are limited remains. Our knowledge of various textile styles from many ancient civilizations rely on other indicators such as paintings, impressions in pottery, carvings and the presence of textile related tools.²

There are three distinct categories of fibers, the first two being ancient and the third modern: cellulose (plant), protein (animal) and artificial (man-made). Dates are represented using the abbreviation BCE (Before Common Era) and CE (Common Era) which have replaced the old designations of BC and AD.

Plant-based Textiles

The earliest evidence we have of textiles is string making, from a sample of dyed and twisted flax fibers dating 31,000 to 36,000 years ago. The invention of spinning seems impossible to ascertain. There are spindle whorl artifacts dating back to the Neolithic period but it is most likely that spinning existed from at least 29,000 BCE. Earliest examples are found in artwork depicting women in string skirts.³

Woven textiles seem to have appeared somewhere around 6,500 BCE. Flax was made into a woven cloth known as linen. It is unclear if this cloth was originally designed for clothing or for religious/ceremonial usage. Remnants were discovered in burial mounds perhaps as burial shrouds. Flax was plentiful in the Mediterranean region. Linen was an ideal lightweight material that worked well in the warm climate of the region.⁴ Many historical sites such as Catal-huyuk in Turkey are in ongoing excavations. That particular site is a large settlement that was occupied from around 7,400 to 5,750 BCE with a population upwards of 8,000 people! Catal-huyuk has been intermittently excavated during the summer months from the years 1960 until present, with the last international excavation taking place in the summer of 2016 before the Turkish government is set to take over excavations.⁵ This site has provided textile remnants that are primarily plant based. While its early head excavator James Mellaart wrote about evidence of possible

wool garments, there hasn't been any remnants identified as such. It is interesting how interpretations of the various buildings have shifted from Mellaart's belief of the presence of religious shrines, to modern interpretations of regular domestic housing. Mellaart also posed that the extensive Kilim patterned paintings on the walls were representative of actual Kilim rugs or textiles.⁶ It remains to be seen if this theory, too, will become "outdated". Plant based Kilim rugs appeared to be born of the Nomadic lifestyle of ancient people because they were light weight and easily rolled for transport but that also meant they were unlikely to survive as intact artifacts.⁷

Close on the heels of Flax came the second plant-based textile material, cotton. It is possible that the initial spread of cotton was incidental, perhaps by people using the fiber as padding in footwear or moving goods. The first cotton was most likely gathered from wild plants, but that would soon lead to purposeful cultivation and wide spread trade of textiles and raw material. The Indus Valley Civilization is often overlooked in common history compared to Egypt and Mesopotamia, but is the location of the oldest evidence of cotton being cultivated and traded. Located around the fertile river floodplains in what is modern day Pakistan, Afghanistan, and India, it is believed that the Indus Valley Civilization began 8,000 or more years BCE, but became highly developed around 3,000 BCE. It was actually a much larger civilization than its contemporaries with whom they traded.⁸ Across the globe, evidence of raw cotton bolls and cloth fragments located in a cave in Mexico were dated 5,000 BCE showing that the rise of cotton use occurred contemporaneously.⁹

Textiles created out of cotton were softer than their flax counterparts, and were quickly in high demand. By 3,000 BCE, there was evidence of cotton crops not only in the Middle East but also in the Americas. Cotton netting dating to about 2,900 BCE was found in Mexico and other textiles were evident throughout Central and South America about the same time. Recent scientific analysis of wild forms of cotton have determined that cotton which grew and was cultivated in the region of Egypt was of a different species than cotton originating in the Indus Valley region. This is also true for the cotton growing in ancient Mexico, Peru, and other regions surrounding the Andes mountains.¹⁰ Since the beginning of my research, a more recent textile find is some fragments of woven cloth from Huacta Prieta, Peru that are estimated to be 6,200 years old (4,250 BCE). Even more exciting to archeologists was the determination that the fragments contained threads that had been dyed with Indigo, making it the oldest known evidence of that dye. The Huacta Prieta textile predates the previous oldest known examples of Indigo use from Egypt by about 1,600 years.¹¹

For all of its widespread use and popularity, cotton as a raw material is not actually user friendly. Separating the cotton from the seeds is tricky, the fibers prove difficult to spin initially and they do not naturally take dyes. These difficulties with cotton probably spurred more technical advances in fiber processing than wool or silk! Even today, cotton requires a chemical process to affix dyes. Ancient India used chemical processes

produced through the use of urine and animal droppings to create their beautifully colored fabrics. They closely guarded those processes for thousands of years, keeping the price of their fabrics high much the way China controlled silk production.

Animal-based Textiles

While archeologists are able to determine that man began keeping sheep as early as 8,200 BCE, they were most likely being kept as live food storage. Sheep hides would have been a happy by-product of this early food management but not likely a primary goal. There is morphological and geographical evidence such as the loss of horns, reduced body size, and relocation from sites of species origins, that by 6,000 BCE sheep populations were changing due to human influences. The ancient sheep breeds were not like the fluffy, woolly coated sheep that resulted from selective breeding over the centuries. Evidence of the woolly sheep wasn't present until around 3,000 BCE. The "wool" in ancient sheep was actually a seasonal undercoat that was either shed then subsequently collected, or pulled out by hand. Perhaps nomadic tribes began collecting shed wool from the fields prior to managing herds.¹²

An essential wool textile was non-woven felt which was made out of compressed and agitated animal hair. There are historical accounts tracing felted items to the Nomadic Tribes of Asia and Europe. While ancient Chinese, Greek and Roman societies may have incorporated felted items through trade they were not an essential part of their culture, whereas the Nomadic Tribes depended on felted textiles for shelter, as well as clothing. In fact, it was the ease of transporting their felted homes that supported their nomadic lifestyle. The art of felt-making is still practiced in many of those cultures today.¹³ Some of the earliest preserved felts are those that were found with the Tarim Mummies of China. Felted hats, "socks", blankets and other textiles date from around 2000 BCE to 200 CE. There is a remnant of a felted carpet from the region of Siberia and felted head-coverings. Many of the felted textiles are dated much earlier such as 4th to 5th Century BCE.¹⁴ A heavier weight material, felt would have been ideal for its properties of insulation either against the intense heat of the desert sun or the freezing temperatures of the higher altitudes.

The weaving of wool likely began by 3,000 BCE or even earlier. Some of the few woven artifacts have been found from burial sites such as the Tarim Mummies, where trousers were found on two male mummies.¹⁵ We know more about the transformation of wool into textiles from related tools such as spindles that are often recovered from archeological sites which will also be discussed shortly.

The wool industry spread throughout the world and eventually drove several significant moments in world history. Spain was responsible for cultivating Merino sheep who produced a very long and beautiful wool fiber. Because the Merino wool was highly coveted, Spain made a lot of money by the sheep which actually led to the funding of

Christopher Columbus' journey to "The New World". England also had a very extensive wool trade and kept large numbers of sheep. They protected this industry by law, complete with severe penalties for any infractions. The Pilgrims acquired sheep from Scotland for their journey to the New World because they were not allowed to take them from Britain. When the Colonies began to increase their wool production they were heavily controlled by the British which was a significant, though hardly known, contribution to the revolutionary war.¹⁶

Around 3,000 BCE the wife of a Chinese Emperor was said to have discovered that cocoons from silk moths could be unwound into a single soft yet strong fiber. Several of the silk filaments from cocoons were then twisted together to create silk thread. The same Empress is credited with inventing the loom used to then weave a soft beautiful fabric that was capable of providing coolness or warmth as needed. The use of silk thread and silk fabric created such an extensive trading route that it became known as "The Silk Road". China guarded its unique process for years which kept silk highly desired and expensive. Such an amazing resource was closely guarded in its production, use and trade for the next 2,000 years. The first spread of the secret was to Korea around 200 BCE, then to India shortly after.¹⁷ Even after the Common Era began, and silk was being widely traded, misinformation about the source of silk was reported by Pliny the Elder in his book of Natural History. Pliny reports that the silk worms rub the down off of leaves then card and comb it into a long fiber that they eventually roll around their bodies to form a nest. Pliny also complains of the indecency of silk garments due to their inability to mask the female form, believing them to be a detriment to civil society.¹⁸ Obviously, society wasn't fazed by the notion of impropriety.

Artificial Fibers

According to Plato, "Necessity is the mother of invention.", I would extend that by saying frustration is the father of innovation. Bobby Graham, another DTI fellow, recently pointed out to me that it isn't really the use or invention of tools that elevates humans above other animals. Plenty of animals utilize tools in their daily existence. Instead it is mankind's need to "do it better" that sets us apart. It is not enough to simply use a tool, we strive to find a neater, faster, easier, more economical, and even a more aesthetically pleasing way, to accomplish a task. It isn't a need to reinvent the wheel but to improve upon it. Often what drives this need to innovate is a sense of frustration with the initial results, or over something interfering with previous results. In the case of synthetic fibers, it was the decrease of availability of silk fibers due to diseases affecting the silk worm industry that brought about change. The frustration of increased costs drove scientists to explore some new avenues to create fibers. Because silk worms feed solely on mulberry leaves, it made sense that the first man-made fiber was created by extracting cellulose from mulberry bark in the 1850's. By the 1920's that fiber became known as Rayon and it marketed for almost half the price of silk.

The E. I. duPont de Nemours & Company, Inc. purchased a French Rayon company in 1920 and spent the next 15 or so years doing research to improve the quality of the product. Finally, the head of their Chemical department convinced the company that their money and efforts would be better spent researching a new fiber instead. That shift in focus eventually resulted in the invention of nylon in the mid-thirties. The original use of nylon in women's hosiery was quickly eclipsed by a multitude of other nylon products that were developed for use in World War II. After the war DuPont turned its production back to women's stockings due to high demand. In time nylon would become an integral part of fashion along with additional spinoff synthetics such as acrylic and polyester, both of which were invented by the E. I. duPont de Nemours & Company, Inc. in the 1950's. This company was also responsible for the creation of micro-fibers in the late 1980's which caused another tidal wave in textile innovation at the turn of the 20th century.

While it does not come up in standard lists of fiber inventions there is another major synthetic that drastically changed the textile market. PTFE, or polytetrafluoroethylene, is a synthetic material that is more commonly known by the trade name Teflon. In the mid 1970's a scientist by the name of Bob Gore was working in his basement laboratory with rods of PTFE. He discovered that if the material was stretched quickly and drastically it transformed into "expanded PTFE" (ePTFE) a fibrous material with amazing qualities of moisture inhibiting while remaining breathable. This material, when sandwiched between two other layers of fabric, was eventually patented as "Gore-Tex". Gore-Tex dominates the world market in outdoor clothing and materials. While recent competitors have come up with similar products, the highly patented and well marketed Gore-Tex reigns supreme. The synthetic material is found in all manner of goods besides clothing and outdoor gear, such as joint replacement prosthetics, space technology, wire insulation, dental floss, and even human tissue replacement! Gore-Fibers are used to create outdoor sewing threads, filtering systems and weaving yarns for large scale industry, as well as the independent consumer.

Artificial fibers revolutionized the textile industry in the last century. It is a source of pride that both of these companies that made major synthetic fibers are located right here in Delaware. These companies are international power houses while retaining hometown roots. Each has been a large scale employer within our state. There are definite opportunities to visit both of these companies or have guest speakers come to local schools.

Tools of the Trade

I could go on at great length about the various inventions and innovations surrounding tools and production but I will limit myself to those considered ancient. It is actually these tools that tell us so much about earliest textiles. Cro-Magnon's eye needle was undoubtedly the first such tool although it was not actually created for, or used immediately, with spun thread.

The next crucial set of tools was that of a distaff, spindle and spindle whorl. The distaff was used to hold the fiber that was being fed to the spindle. While the fiber could also simply be held in the other hand, the distaff allowed for a greater amount to be held, while simultaneously freeing the hand to assist in drafting and spinning. Often shown in artwork, the distaff was held pinned between the left arm and side. The term distaff to this day is used to reference the maternal side of the family tree. The distaff is eventually shown free standing or being held by another helper. Used to both collect the spun thread and assist in the process, by means of a weight to perpetuate rotation, spindle whorls have been found in archeological excavations the world over. While the shaft of the spindle was rarely preserved, the stone, bone, or clay whorl typically endured. This form of hand spinning is so effective that it is still in practice today with minor variations.

One interesting tool from Greek civilization is the epinetron. Made in pottery and often decorated, the epinetron was made to fit over a woman's thigh to assist in hand spinning by providing a protective but textured surface. The decorations on the epinetrons often depict women in various stages of textile productions.

Artifacts of ancient looms come in the form of loom weights, their wooden frames long disintegrated. We believe that looms originated in the late Neolithic period and were initially upright and eventually horizontal. Most of our knowledge of ancient looms comes from written records and artwork. Farming and herding was able to provide ready resources for textiles that most likely gave rise to improved implements.

The last possible invention from BCE is a rolling device that was used to separate cotton fiber from the seeds as depicted in paintings from the Adjanta Caves in India circa 100 BCE.¹⁹ This ancient tool was a precursor to the Cotton Gin which wasn't invented for another 2,000 years.

Coming much later, spinning wheels would be the next major invention to revolutionize textile production. Origins of the spinning wheel are unclear but were probably India or China around 1200 CE according to literary references and art. It would take another hundred years for the spinning wheel to become part of the European household. Improvements to spinning wheels and looms would continue across centuries, eventually giving rise to textile mills and mass production through automation.

The Language of Textiles

I would be remiss to not reflect on textiles' rich contributions to language, storytelling, art and song. Words woven into the warp and weft of our daily dialogue as we spin the yarns that define the very fabric of our lives, address the fiber of our characters, and the weaving of our dreams. These terms and more have translated through multiple languages and cultures. Ancient to modern artwork showcases the creation of textiles as

well as the final products. Universally, textiles are featured in story and song that reflect both the diversity and the similarities in all cultures. Fairy Tales, myths, folklore and fables frequently feature textiles of importance. Greek mythology tells of the songs of weavers that described what patterns to weave; Kilim rugs from Persia whose very patterns spoke the language of the heart; songs sung by Navajo weavers defining their sense of self and home all signify our closely bound ties with textiles. There are so many examples of these relationships, I urge additional research to tailor this Unit to any class' specific focus.

Textile Products

Clothing, floor coverings, shelters, bedding, storage, protective gear, artwork, the list of significant textiles seems endless. Textiles improved the survival rate of humans in often daunting environmental conditions. We have fashioned items for utility and aesthetics throughout the ages. Many ancient textile production processes are still practiced today such as Kilim rugs and Persian carpets. Just as they were in ancient times, these textiles are indicative of not only the craftsmanship and culture of the producer, but the financial status of the consumer. There are textiles that are so iconic that they are instantly recognizable: Greek/Roman togas, Scottish kilts, Indian saris, Central/South American ponchos and blankets, Middle Eastern hajibs, Scandinavian sweaters, Germanic lederhosen, Persian/Oriental carpets, Turkish bath towels, Egyptian cotton sheets, DuPont nylon, Gore-Tex, and more.

Many textiles used patterns specific to their region. This is clearly seen in the making of carpets. The oldest hand knotted carpet found has a very complex pattern, including a border of horsemen and elk. The elk even have symbols of internal organs appropriately placed as part of their design. The textile was preserved in ice in the Siberian region and dates to around 6th century BCE. Historians believe it originated in Persia due to correlating design features.²⁰

In ancient times textile production originally occurred at the household level before becoming communal then eventually commercial. Textiles were created by peasants, as well as those of higher social standing, often shared between slaves and rulers. The industry at times, or in parts, has been the work of women, men and both. Textiles have been the saving grace and the bane of existence for every aspect of civilization across the ages, capable of creating routes for multicultural exchanges and diversity but also giving rise to deplorable systems such as slavery, child labor, sweatshops and environmental destruction.

While initially driven by need and practicality, demand for textiles rapidly shifted to want, even back in ancient times. Invention and innovation provided the ability to diversify the materials, production and product of textiles but it also has fed the insatiable desires of mankind. Many people are finally mobilizing to address the extensive fall out

of our wasteful society that is driven by fashion. The term “fashion” may initially seem to imply clothing but the reality is that fashion, or style, is the desire for things based on what is deemed popular by mainstream society. Popularity is driven by marketing in presentation, advertising and packaging. Much explanation of this vicious cycle is available in the book, *Waste and Want – A Social History of Trash*, by Susan Strasser. Strasser points out that that the term “fashion” applies to everything: cars, appliances, clothing, behaviors, and practices.²¹

The most devastating fashion change has taken place in the last 100 or so years, in the form of disposability. The beginning of 19th century society ushered in a combination of heightened concern for health and sanitation, along with increased technology, which led to the popularity of disposable products. So began our modern “Trash and Replace” mentality. Fortunately, there has been a new trend in fashion lately known as “Zero Waste”. Conceptualized in the 1970’s, the Zero Waste movement has been catapulted into the mainstream by young millennials seeking to reclaim planet earth.

“Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use. Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health.”

Zero Waste International Alliance

The most significant difference between Zero Waste and the Recycling movement is the return to a belief system of creating products that are designed to last, thus reducing environmental impact at all phases of production. The easiest example of this is producing a package that can be repeatedly reused, versus one that can be recycled which still wastes resources.²² Textiles are actually the perfect vehicle to achieve these goals. Yes, plastic bags are recyclable, but a woven natural fabric bag may be reused indefinitely, repaired as needed, and once worn out can be composted, giving back to the earth. While some zero waste proponents are actually anti-recycling because they feel it perpetuates the creation of “throw away” quality items, we still need to address the massive quantity of stuff we already have. Textile recycling provides an opportunity to repurpose and reuse that which is already glutting our market, while still providing the opportunity to educate society about redesigning products for sustainability.²³ Our schools are the perfect place to start implementing some of these major shifts in mentality and practice to preserve the future of our planet. There are multiple resources online that allow students to follow the whole cycle of various textiles like the basic T-shirt.

Looking Forward

Taking a Project-Based approach to teaching any of this material will lead you on a unique journey every time. My students always surprise me even though they are “only second graders” who lack in so many life experiences that I was fortunate enough to have growing up. In large, my students haven’t been to museums or reenactments, and even the typical school field trips have fallen few and far between. What today’s children do have is a wealth of online exposure and experience (sadly, not always good) that give them different, often random, views of their world. As teachers we must capitalize on the existing skill sets while trying to provide a sound framework for comprehending the world as a whole. One of the most amazing things I took away from the Ancient Inventions Seminar was the incredible resourcefulness of humans and their ability to create and innovate even without all of the “modern day technology” that we take for granted.

After our Unit Introduction lesson, I modeled for my students the way wool can be pulled into string by drafting and hand spinning against your thigh. After lunch that day one of my students approached me with excitement, “Mrs. Frasher, look what I made! I just started pulling this and now it is fiber!” This student usually performs somewhere in the middle and doesn’t typically put in extra effort to her learning. Lacking in strong social skills, she also struggles with anger management issues, often “melting down” or having emotional outbursts when frustrated that frequently leads to the destruction of nearby items such as her pencil, erasers, and papers. In the cafeteria during lunch she must have wrestled with some emotional situation. The item she had on hand to destroy was her plastic wrapped silverware packet. In a “slow burn” mode she pulled the wrapper in her hand unwittingly with just the right pressure that stretched the material but did not break it. At first frustrated (she wanted breakage) she was suddenly intrigued, and continued to pull, drafting the plastic out gently but firmly, ending up with a long shiny fiber. She immediately gathered wrappers from everyone nearby and repeated the process, returning to class with a handful of her innovation and brimming with eagerness to learn more. How similar her experience was to the creation of Gore-Tex! I had her share her innovation with the class and now they all save wrappers and practice pulling them (it is a bit tricky). When other classes in the cafeteria saw them collecting wrappers they began sending theirs over to our table. All of this happened with no directing on my part. This is classic innovation and repurposing of materials. Our class plans to use the fibers to weave bracelets and maybe some decorative items. We will eventually share our learning with the rest of the school community...we just need to polish our process and product first!

Unit Overview

The unit will be cross curricular with students initially learning some of the history of textiles, then reading both nonfiction and fiction stories about the processes of fiber

preparation and textile creation. The readings will serve to expose students to the close relationship between humans and the role of textiles in both agriculture, economics and the environment. We will study the different fibers that were initially used in textile production and the methods used. It is essential to also learn about the acquisition of the raw materials, and the advances in production that revolutionized the textile industry. Students will have the opportunity to interact with raw materials and experience different forms of preparation and hand production, some of which are still used in many areas of the world today. This immersion approach allows students to feel connected to both ancient and current cultures across the globe. My hope is that they will also realize the level of creativity and innovation (both individual and collective) attained by those without the benefit of all of our modern technology and instant information access. It is imperative that the students not just learn about the historical significance of textiles, but the future implications, as well. Students will create flow charts showing the modern day journey of some basic textiles in today's market and the resulting environmental footprint of the "throw away" textile mentality. Lastly we will research efforts by some textile companies to repurpose or recycle textiles in an effort to be more environmentally conscious, culminating in the schoolwide adoption of a textile recycling program.

Unit Introduction

Our District writing curriculum is *Explorations in Nonfiction Writing*. It includes a strategy known as "R.A.N." which stands for Reading and Analyzing Nonfiction. The authors reimagined the standard KWL chart and came up with a new graphic organizer called the R.A.N. Chart.²⁴ This is the fourth year I have used this chart in my classroom for a variety of topics. I often use it in conjunction with Social Studies and Science content. One of the major distinctions of this graphic organizer is its categorization of "What we think we know" details, into either "Confirmed", or "Misconception" so students can recognize when they have made adjustments to their schema. Finally, the strategy has students identify "New Learning" and "New Questions" which is a crucial component of a Project-based approach.²⁵ As has definitely been the case with my own research for this unit, when students think about how the new information impacts their understanding it sparks the desire to know more. The resulting chain reaction engages students in ownership of and direction for their own learning, a key component in developing life-long learners.

Activities

Reading – Read Aloud stories

The list of books I wanted to share grew exponentially. I think it would be important to see which books may be available through your school and local libraries, before deciding to purchase any. Significant attention should be paid to having a multicultural representation, as well as nonfiction/fiction balance in the books that you select.

Books are listed at end of unit. (Appendix A)

Lesson 1- Textiles: Establishing focus of the unit (2-3 sessions)

Read aloud a non-fiction and a fiction story (from list)

Essential Questions:

1. What is the message or focus of the fiction and non-fiction texts?
2. How does the focus of the two texts compare and contrast?
3. How do these ideas connect to us in present times?

EQ 1) Have students utilize Turn and Talk with an Elbow Buddy prior to sharing their partner's thoughts with the class. This is the best gauge of whether or not the students have grasped the intended lesson content prior to proceeding with a written response to the reading.

EQ 2) Utilize either a Reading Journal or a Project Journal for recording their written response to the lesson. Have students complete a compare/contrast graphic organizer. I tend to use I-chart organizers but a Venn diagram would work equally.

EQ 3) Students share their responses in small groups to come up with their ideas about how these two texts are connected to us currently. They will then collaboratively record the group's ideas onto a small poster (9x18) prior to sharing with the whole group.

This activity will be repeated across multiple readings with some variation.

Social Studies/Non-fiction Writing

Lesson 2 - World Geography and textiles. (Multiple Sessions)

There are a wide variety of resources listed at the end of the Unit that would be appropriate for providing students information on each of the subtopics below. The Internet resources are excellent for selecting age appropriate formats for varying groups of students. This section of the Unit is also where I would insert the Economic implications of ancient and modern textile production and distribution.

Mapping of Ancient Textiles and Trade Routes – Use map overlays to show students the present day location of ancient regions and civilizations.

Mapping of Cultures around the world with textile traditions that are still extant – map the locales for each of the Read Aloud Texts that you choose. A particularly good book to use for this purpose is “*The Fabrics of Fairy Tale – Stories spun from far and wide*” Retold by Tanya Robyn Batt which uses 8 different folktales to introduce students to textiles found in each originating culture. The other collection of books that would work well for this are the books on traditional weaving practices that continue to present day.

Mapping of Modern Day Textile Production and Distribution – This would be the section to focus on artificial fibers and “The Life” of any particular textile such as an everyday t-shirt.

Essential Questions:

1. What is our current schema for the origins of various textiles on a world map?
2. How does our new learning confirm or refute aspects of our previous schema?
3. How are the economics of supply and demand evident in the maps?
4. What new questions does this information create?

EQ 1) Utilize the smartboard to display both a current world map and one of antiquity. Record students’ schema for the maps on the “What We Think We Know” portion of the R.A.N. chart.

EQ 2) For each Read Aloud, mark significant locations on both maps. Have students record their thoughts in their Unit journal. Revisit the R.A.N. chart and record findings in appropriate categories. I recommend using physical maps in addition to Smart documents so that the information is always on display. Using colored dot stickers is an easy way to categorize the map locations.

EQ 3) Define supply and demand as it applies to raw materials, processing, production and distribution of textiles. Discuss with whole class any patterns that emerge on the maps.

EQ 4) Students may work individually, partnered, or small group to determine new questions and desired research topics. Add this new information to the R.A.N. chart. Notations can be added to maps to indicate important locations relating to their research. Hold whole class discussions to identify focus shifts.

Lesson 3 – Tools of the Trade

The tools of production from Ancient to Modern Day. Create a timeline of tools complete with pictures, or models, and descriptions (Ancient Inventions Smith.edu inspired) Possibly take a field trip to a working mill or a former mill. Online museum websites are excellent for providing students with pictures and descriptions. A paper timeline could be created going around the room or down the hall. A Power Point presentation could be developed or there are a variety of online timeline creation activities.

A joint venture with the Art class is planned for the students to create some simple looms for weaving their spun fiber.

Essential Questions:

1. What tools existed in ancient times related to textiles?
2. How did the invention various tools and processes impact textile production?

3. What modern textile innovations revolutionized the industry?

EQ 1) Begin a timeline of ancient tools related to textiles using both pictures and words.

EQ 2) Discuss changes brought about by each additional invention or innovation as you add them to the timeline.

EQ 3) As you add the more recent changes in the textile industry be sure to discuss what tools or process created drastic changes versus minor changes.

Lesson 4 – Wool Production

Students will process wool from “raw” state to hand spinning and dyeing. Students will reference stories that we have read to take a fleece through the different stages required to produce a final yarn. Yarn can then be woven using basic methods. (Working with Art teacher on the weaving aspect) May include field trip to local farm to witness shearing, otherwise there are online videos to share. Anyone using the Unit could choose to follow this process with a different fiber.

Essential Questions:

4. How do we prepare our raw material to create fiber?
5. How do we transform our raw material into fiber?
6. What textile can we create using our new fiber?

EQ 1) Have students work with a fleece to get it washed, dried, and carded. Be sure to explain that incorrect handling can ruin the fleece; over agitating or drastic temperature changes can cause the fleece to felt together instead of being able to be spun. Removal of the Lanolin is achieved through use of soap and hot water but if the then dirty water is allowed to cool on the wool, the lanolin will recoat the fleece permanently, again ruining its use for spinning into fiber.

EQ 2) Students will hand spin the wool first using just their hand(s) and leg, then using a drop spindle, a form of hand spinning that is still used in some cultures. Students will be able to dye their spun wool.

EQ 3) Students will then be able to use their fiber to create some type of textile.

Culminating Activity

Lesson 5 – Textile Recycling

The afterlife of textiles will be studied geographically and economically. Students will choose a textile recycling program and implement it at the school to include writing letters to initiate partnership in program, and marketing the program to the school and local community.

Essential Questions:

1. How can we utilize local organizations in our recycling efforts?
2. How can we institute a textile recycling program for our school community?
3. How can we share our Unit experiences with others to raise awareness?

EQ 1) Identify locally existing resources for textile recycling such as the Goodwill.

EQ 2) Teach students format of a formal business letter. Identify local organizations to contact and have students write letters explaining their stewardship efforts and requesting partnership in accessing and utilizing resources. Be sure give concrete reasons and examples.

EQ 3) Invite local organizations to participate in Unit activities whenever possible. Publish activities, findings and experiences in places that are accessible to the general public. Some suggested places are Classroom and School websites, local newspapers, other community buildings, events, or print materials.

Appendix A

Books for Read Alouds

Processing to Product

Woolbur by Leslie Helakoski

A New Coat for Anna (Dragonfly Books) by Harriet Ziefert

Something from Nothing by Phoebe Gilman

Fairy/Folktale

The Fabrics of Fairy Tale – Stories spun from far and wide Retold by Tanya Robyn Batt

Rumpelstiltskin's Daughter by Diane Stanley

The Little Overcoat – Traditional Folksong adapted by Yetta Trachtman Goodman

Weaving

The Goat in the Rug by Charles L. Blood

The Roses in My Carpets by Rukhsana Khan

Songs from the Loom: A Navajo Girl Learns to Weave (We Are Still Here) by Monty Roessel

Environmental

The Lorax by Dr. Suess

A River Ran Wild by Lynne Cherry

Teacher Reads

For in-depth explanation about the different fibers and their applications, with a bit of their history. Especially good if you plan to actually spin fiber with your students.

The Practical Spinner's Guide Series: *Wool* by Kate Larson; *Rare Luxury Fibers* by Judith Mackenzie; *Silk* by Sara Lamb; *Cotton, Flax, and Hemp* by Stephanie Gaustad.

Appendix B

Implementing District Standards

Common Core State Standards ELA-Literacy Informational Text

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.

RI.2.6 Identify the main purpose of a text, including what the author wants to answer, explain, or describe

RI.2.8 Describe how reasons support specific points the author makes in a text.

RI.2.9 Compare and contrast the most important points presented by two texts on the same topic.

Common Core State Standards ELA-Writing

W.2.2 Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.

W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

Delaware State Social Studies Standards

History Standard Two: Students will gather, examine, and analyze historical data.

K-3: students will use artifacts and documents to gather information about the past.

History Standard Three: Students will interpret historical data.

K-3: students will understand that historical accounts are constructed by drawing logical inferences from artifacts and documents.

Geography Standard Three: Students will develop an understanding of the diversity of human culture and the unique nature of places.

K-3: students will identify types of human settlement, connections between settlements, and the types of activities found in each.

K-3a: Students will identify human wants and the various resources and strategies, which have been used to satisfy them over time.

Economics Anchor Standard Four: Students will examine the patterns and results of international trade [International trade].

K-3a: Students will understand that the exchange of goods and services around the world creates economic interdependence between people in different places.

Notes

- 1 History of fibres natural and manmade fibres, Textile School
- 2 The Ancient World - Prehistoric-Clothing, Encyclopedia of Fashion
- 3 Barber, *Women's Work: The First 20,000 Years: Women, Cloth, and Society in Early Times* (1994) 44.
- 4 History of Textiles, When did People Learn to Make Cloth? About Education, Archeology
- 5 Catalhoyuk Site Guidebook pdf, Catalhoyuk Research Project, World Heritage Site
- 6 Mellaart J, Catal-huyuk A Neolithic Town in Anatolia. (1967) pdf, 152-155, 161, 219, 220
- 7 Weaving through Turkey's history of kilims, Turkey Pulse, Al-Monitor
- 8 The Harappan Civilization by Tarini Carr. Archaeology Online
- 9 The Story of Cotton-History of Cotton, Cotton Counts
- 10 Smith, *Crop Production: Evolution, History, and Technology* (1995) 287-345
- 11 Early pre-Hispanic use of indigo blue in Peru., Science Advances
- 12 A forager-herder trade-off, from broad-spectrum hunting to sheep management at A kl Hoyuk, Turkey. Proceedings of the National Academy of Sciences 111, no. 23 (2014)
- 13 The Early History of Felt, Laufer, American Anthropologist 32, no. 1 (1930) 2
- 14 Pile Carpet, Hermitage Museum
- 15 The Tarim Mummies, World-Mysteries Blog
- 16 History Of Wool.pdf, American Wool, SheepUSA
- 17 History of Silk, Silkroad Foundation
- 18 Pliny (the Elder.), *The Natural History of Pliny, Volume 3, 25-27*
- 19 Ancient Cotton, Brooks, The Ancient World, University of California, Santa Cruz
- 20 Oldest carpet in the world: Pazyryk Rug, Museum of Artifacts
- 21 Susan Strasser, *Waste and Want – A Social History of Trash*,
- 22 ZW Business Principles, Zero Waste International Alliance
- 23 Wear It? Recycle It!, Educators & Kids, Secondary Materials and Recycled Textiles Association
- 24 Tony Stead and Linda Hoyt, R.A.N. Chart, *Explorations in Nonfiction Writing, Resources*, 295-7
- 25 Tony Stead and Linda Hoyt, R.A.N. Strategy, *Explorations in Nonfiction Writing, Resources* 297-305

Bibliography

- "A Picture of Women Weaving in the History." A Picture of Women Weaving in the History. Accessed Nov. & Dec. 2016.
http://webarchives.mansfield.edu/~art/Papyrus2GeoffreyBeadlea_picture_of_women_weaving_in_th.htm.
- "A Short History of Man Made Fabrics." Andy Kirkpatrick. Accessed Nov. & Dec. 2016.
http://andy-kirkpatrick.com/articles/view/a_short_history_of_man_made_fabrics.
- "Ahimsa, or Peace Silk." Ahimsa, or Peace Silk. Accessed Sept. & Oct. 2016.
<http://www.wormspit.com/peacesilk.htm>. Type of silk where moth is not killed for harvesting of cocoons.
- "Ancient cotton." Ancient cotton. Accessed Nov. & Dec. 2016.
http://cwh.ucsc.edu/brooks/The_Ancient_World.html.
- Aulenback, Stephany. "Necessity Is the Mother of Invention." McSweeney's Internet Tendency. May 8, 2002. Accessed January 2017.
<https://www.mcsweeneys.net/articles/necessity-is-the-mother-of-invention>. Thought provoking anthropomorphic tale for the teacher, high school, or college level readers.
- Barber, E. J. W. Women's work: the first 20,000 years: women, cloth, and society in early times. New York: Norton, 1994. Worth the read for the Introduction alone. Author explains her efforts to reproduce an ancient woven textile and what she learned is key from an archeological standpoint!
- "Brief History of Sheep and Wool." History of Sheep and Wool, Sheep Wool Production, Wool Garments, Sheep Industry, Wool Textiles, Fibre2fashion. Accessed Oct. & Nov. 2016. <http://www.fibre2fashion.com/industry-article/4295/brief-history-of-sheep-and-wool?page=1>.
- Burke, B. From Minos to Midas: Ancient Cloth Production in the Aegean and in Anatolia (Ancient Textiles Series). Oxbow Books, 2010. Use WorldCat
- Carr, Tarini. "The Harappan Civilization by Tarini Carr." Archaeology Online. Accessed Nov. & Dec. 2016. <http://archaeologyonline.net/artifacts/harappa-mohenjodaro>. Excavations of the Indus Valley
- "Çatalhöyük Research Project | Excavations of a Neolithic Anatolian höyük." Çatalhöyük Research Project | Excavations of a neolithic anatolian höyük. Accessed Nov. & Dec. 2016. <http://www.catalhoyuk.com/sites/default/files/Catalhoyuk-Guidebook-ENGLISH.pdf>. Guidebook for actual Çatalhöyük excavation site with illustrations.
- "Chemical Heritage Foundation | Home." Chemical Heritage Foundation | Home. Accessed January 2017. <https://www.chemheritage.org/>. Museum located in Philadelphia, PA. Open to student tours. Website also has Historical Biography links.

"China and India." China and India. Accessed January 2016.
http://cwh.ucsc.edu/brooks/China_and_India.html. Cotton

Clutton-Brock, Juliet. A natural history of domesticated mammals. Cambridge, U.K.: Cambridge University Press, 1999. The process and spread of domestication through the ancient world.

"Council for Textile Recycling." Council for Textile Recycling. Accessed Nov. & Dec. 2016. <http://weardonaterecycle.org/>.

"Crash Course World History Curriculum." Crash Course Lesson Plans. Accessed Oct. & Nov. 2016. <http://thecrashcourse.com/curriculum.html>. Curriculum guide with PDFs for teachers and students to accompany the online Crash Course history video series. Great background information for teachers and upper grade students.

"Definition of textiles for the clothing and textile industry." Definition of textiles for the clothing and textile industry. Accessed Nov. & Dec. 2016.
http://www.apparelsearch.com/definitions/fabric/textile_definition.htm. Textile definitions

"FabricLink: Fabric Seminar." FabricLink: Fabric Seminar. Accessed Nov. & Dec. 2017.
<http://www.fabriclink.com/University/History.cfm>. Chart form of fiber inventions, natural and artificial.

"Felt items throughout History project: The Tarim River Basin Mummies." Adventures in Wool Addiction. March 16, 2009. Accessed Nov. & Dec. 2016.
<https://ladyvirag.wordpress.com/felt-items-throughout-history-project-the-tarim-river-basin-mummies/>.

"FiberSource: The Manufactured Fiber Industry." American Fiber Manufacturers Association / Fiber Economics Bureau Accessed January 2017.
<http://www.fibersource.com/fiber.html>. Resource on artificial fibers.

Gambino, Megan. "If Necessity Is the Mother of Invention, Then Play Is Its Father." Smithsonian.com. Accessed January 2017.
<http://www.smithsonianmag.com/innovation/if-necessity-mother-invention-then-play-its-father-180961107/>. Interview of Steven Johnson (Wonderland: How Play Made the Modern World) referencing the inspiration for the Jacquard loom, that eventually contributed to computer programming.

Gordon, Beverly. Textiles: the whole story: uses, meanings, significance. London: Thames & Hudson, 2011. Beautifully illustrated.

"Gore-Tex: An Introduction to the Material and Treatments." Gore-Tex: An Introduction to the Material and Treatments. Accessed January 2017. <http://cool.conservaion-us.org/coolaic/sg/bpg/annual/v11/bp11-33.html>. Full description of Gore-Tex but also a very interesting explanation of its use in conservation of museum documents.

GW-textile-museum. "GW-textile-museum." The GW University Museum and the Textile Museum. August 10, 2016. Accessed Nov. & Dec. 2016. <http://gw-textile-museum.tumblr.com/post/148739747418/it-takes-a-team-of-conservators-and-hours-of-conservation-methods>

"Hermitage." Hermitage. Accessed Nov. & Dec. 2016. <http://www.heritagemuseum.org/>. Online Museum access. Beautiful pictures especially felted items

TextileSchool.com. "History of Fibres - Natural and Manmade Fibres." TextileSchool.com. Accessed Nov. & Dec. 2016. <http://www.textileschool.com/articles/356/history-of-fibres-natural-and-manmade-fibres>. Fiber descriptions

"History of Weaving." History of Weaving - Weaving in Ancient World. Accessed January 2016. <http://www.historyofclothing.com/making-clothing/history-of-weaving/>.

"How is Silk Made?" Today I Found Out. October 31, 2014. Accessed Oct. & Nov. 2016. <http://www.todayifoundout.com/index.php/2014/10/real-silk-made/>.

Irby-Massie, Georgia Lynette. A companion to science, technology, and medicine in ancient Greece and Rome. Chichester: Wiley Blackwell, 2016. Use WorldCat

"January/February 2017." Discover Magazine. Accessed Nov. & Dec. 2016. <http://discovermagazine.com/1994/apr/themummiesofxinj359/>.

Johnson, Steven. Wonderland: how play made the modern world. New York: Riverhead Books, 2016. A look at inventions and innovations intended for pleasure, gave rise to significant later innovations.

Koch, Wendy. "Clothes recycling goes curbside as demand rises." USA TODAY, April 20, 2013. Accessed Sept. & Oct. 2016. <http://www.usatoday.com/story/news/nation/2013/04/20/recycling-clothes-expands-curbside/2092351/>.

Lane, Al. "Timeline of Fabric History." Timeline of Fabric History. Accessed Nov. & Dec. 2016. <http://threadsintyme.tripod.com/timelineoffabrighistory.htm>.

Laufer, Berthold. "The Early History of Felt." American Anthropologist 32, no. 1 (1930): 1-18. doi:10.1525/aa.1930.32.1.02a00020. Online scanned copy of journal in PDF

Lee, Silkroad Foundation Adela C.Y. "History of Silk." History of Silk. Accessed Oct. & Nov. 2016. <http://www.silk-road.com/artl/silkhistory.shtml>.

Leonard, Annie, and Ariane Conrad. *The story of stuff: how our obsession with stuff is trashing the planet, our communities, and our health--and a vision for change*. New York: Free Press, 2010. Devastating details about the Environmental and Socioeconomic footprints of common industries.

Liu, Xinru. *The Silk Road in world history*. Oxford: Oxford University Press, 2010. Use WorldCat

Mellaart, James. *Çatal Hüyük: a Neolithic town in Anatolia*. New York: McGraw-Hill, 1967. Archived PDF available online

Michel, Cécile, and C. Breniquet. *Wool Economy in the Ancient Near East and the Aegean: From the Beginnings of Sheep Husbandry to Institutional Textile Industry*. Oxbow Books, 2014. Collection of papers on history of wool husbandry and textile production. Modern day craftswomen support archeological research through application of theories.

"News & Events." Ancient Egyptian cotton unveils secrets of domesticated crop evolution. Accessed Nov. & Dec. 2016. http://www2.warwick.ac.uk/newsandevents/pressreleases/ancient_egyptian_cotton/.

"Oldest carpet in the world: Pazyryk Rug." Museum of Artifacts. Accessed Nov. & Dec. 2016. <http://museum-of-artifacts.blogspot.com/2015/10/oldest-carpet-in-world-pazyryk-rug.html>.

Oleson, John Peter. *The Oxford handbook of engineering and technology in the classical world*. Oxford: Oxford University Press, 2008. Fibers: Harvesting and Preparation. Comprehensive

Petzel, Florence Eloise. *Textiles of ancient Mesopotamia, Persia, and Egypt*. Corvallis, Or.?: F.E. Petzel, 1987. Use WorldCat

Rogers, Heather. *Green gone wrong: how our economy is undermining the environmental revolution*. New York: Scribner, 2010. Changing production processes rather than just focusing on recycling.

Says, Jason, and Elijah Says. "The Tarim Mummies." *World Mysteries Blog*. December 16, 2014. Accessed Nov. & Dec. 2016. <http://blog.world-mysteries.com/strange-artifacts/the-tarim-mummies>.

"SMART: Educators & Kids." SMART: Educators & Kids. Accessed Sept. & Oct. 2016. <http://www.smartasn.org/educators-kids/index.cfm>. Links for textile recycling programs

Smith, C. Wayne. *Crop production: evolution, history, and technology*. New York: J. Wiley, 1995. Cotton production

"Smithsonian Education - Welcome." Smithsonian Education - Welcome. Accessed Nov. & Dec. 2016. http://www.smithsonianeducation.org/educators/lesson_plans/spinning_yarns/ATZ_SpinningYarns_Sep1980.pdf. Newsletter on "Spinning Yarns, Telling Tales about Textiles"

Splitstoser, Jeffrey C. "Early pre-Hispanic use of indigo blue in Peru." Early pre-Hispanic use of indigo blue in Peru | Science Advances. Accessed Nov. & Dec. 2016. <http://advances.sciencemag.org/content/2/9/e1501623.full>.

Stiner, M. C., H. Buitenhuis, G. Duru, S. L. Kuhn, S. M. Mentzer, N. D. Munro, N. Pollath, J. Quade, G. Tsartsidou, and M. Ozba Aran. "A forager-herder trade-off, from broad-spectrum hunting to sheep management at Akl Hoyuk, Turkey." Proceedings of the National Academy of Sciences 111, no. 23 (2014): 8404-409. doi:10.1073/pnas.1322723111. Explanation of how early man became herders

"The Beauty of Loulan and the Tattooed Mummies of the Tarim Basin." Ancient Origins. Accessed Nov. & Dec. 2016. <http://www.ancient-origins.net/ancient-places-asia/beauty-loulan-and-tattooed-mummies-tarim-basin-001227>. Beautiful photographs

"The Gore Story." The Gore Story | History and Information | Gore. Accessed January 2017. <https://www.gore.com/about/the-gore-story>.

"The Harappan Civilization by Tarini Carr." Archaeology Online. Accessed Nov. & Dec. 2016. <http://archaeologyonline.net/artifacts/harappa-mohenjodaro>.

"The natural history of Pliny: Pliny, the Elder: Free Download & Streaming." Internet Archive. Accessed Nov. & Dec. 2016. <https://archive.org/details/naturalhistoryof03plin>. Archived, scanned book that describes ancient Roman culture, 25-27 on silk

"The Official Website of Author & Storyteller Rukhsana Khan ~ RukhsanaKhan.com", Rukhsana Khan. Accessed January 2017. <http://www.rukhsanakhan.com/>. Author page with links to video of read aloud "The Roses in My Carpet" and many other resources. Excellent insight to middle eastern culture.

"The Role of Women in the Art of Ancient Greece." The Role of Women in the Art of Ancient Greece. Accessed Nov. & Dec. 2016. <http://www.rwaag.org/>. Comprehensive list of topics on how ancient women were represented in the arts with bibliography link. Useful for finding stories and artwork to support unit research.

"The Story of Cotton- History of Cotton." The Story of Cotton- History of Cotton. Accessed Nov. & Dec. 2016. <https://www.cotton.org/pubs/cottoncounts/story>.

"Timeline Outline View Era: 2,800,000 BCE - 8,000 BCE | Theme: All Themes." Timeline Outline View: HistoryofInformation.com. Accessed Nov. & Dec. 2016. <http://www.historyofinformation.com/>. A fully searchable timeline. Can search by time frame or theme

"Trans-Americas Trading Co. - Charity Fundraising through Recycling." Trans-Americas Trading Co.- Charity Fundraising through Recycling. Accessed October 2016. <http://www.trancco.com/charities.asp>.

Tremblay, Pinar. "Weaving through Turkey's history of kilims." Al-Monitor. September 03, 2015. Accessed January 2017. <http://www.al-monitor.com/pulse/ja/originals/2015/08/turkey-cultural-heritage-kilim-natural-dyed-carpet-tribal.html>. General reference for Kilim rugs

Watson, Kate Heintz. Textiles and clothing: by Kate Heintz Watson. Chicago: American School of Home Economics, 1907. Though written at the beginning of the 20th century, this archived copy has clear definitions, background information and photographs for all natural fibers and the early processes of textile production.

<https://archive.org/details/textilesclothing00watsscanned> copy of the book

"Weaving through Turkey's history of kilims." Al-Monitor. September 03, 2015. Accessed Nov. & Dec. 2016. <http://www.al-monitor.com/pulse/originals/2015/08/turkey-cultural-heritage-kilim-natural-dyed-carpet-tribal.html>.

"Who We Are." Who We Are | GrassRoots Recycling Network. Accessed January 22, 2017. <http://www.grrn.org/page/who-we-are>. Organization for the Zero Waste initiative USA

"ZW Business Principles." Zero Waste International Alliance. Accessed Nov. & Dec. 2016. <http://zwia.org/standards/zw-business-principles> Clear statement of Zero Waste philosophy